



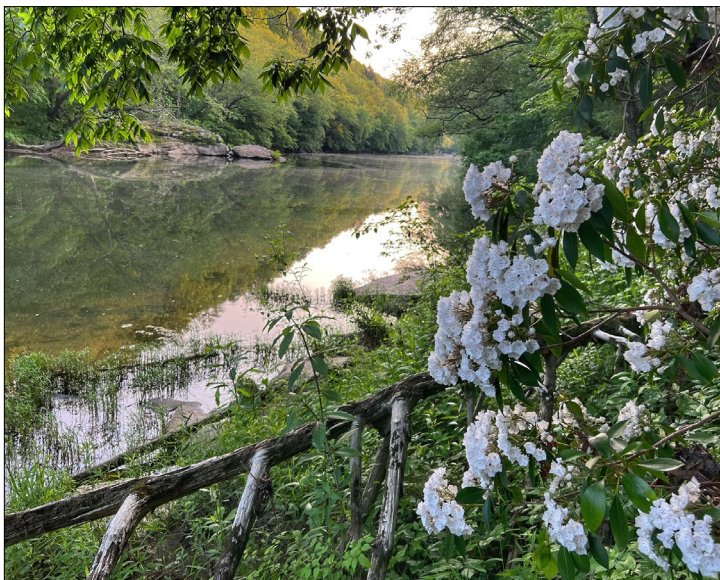
Discrete Water Quality Monitoring: Water Year 2023

Background

Water resources within Big South Fork National River and Recreation Area (BISO) include approximately 80 miles (129 kilometers) of the Big South Fork of the Cumberland River along with its two major tributaries, Clear Fork and New River. In addition, there are hundreds of miles of tributaries and headwater streams within the park's 125,000 acres (50,585 hectares).

The BISO rivers and streams sustain nationally important freshwater fauna, including 11 federally-listed mussel species and the only population in existence of the federally-endangered tuxedo darter (*Etheostoma lemniscatum*). Big South Fork National River and Recreation Area (NRRRA) supports one of the largest concentrations and some of the most pristine examples remaining of the globally-imperiled Cumberlandian cobble bar or riverside scour prairie. These cobble bar prairies and the rare species that inhabit them thrive in the presence of frequent flood disturbance and are dependent upon natural flood regimes and unpolluted water.

Big South Fork National River and Recreation Area occupies a small, downstream portion of its large (1,120 square mile [2,901 square kilometers]) watershed, and therefore, the health of its aquatic systems is dependent to a large degree on external factors.



Mountain laurel on the banks of Clear Fork. NPS photos / APHN staff.

Highlights

- There were no violations of water quality standards.
- Specific conductance at Pine Creek was elevated.
- ANC was low at four sites, indicating sensitivity to acid inputs.
- *E. coli* was generally low at all sites.
- Overall, water quality conditions in WY23 were good throughout the park.

Issues of Management Concern

The primary threats to water quality at Big South Fork National River and Recreation Area are related to acid mine drainage from coal mines, sedimentation associated with mining and roads and trails, and impacts from timber harvest, agriculture, water development, and oil and gas activities.

Monitoring and Objectives

The Appalachian Highlands Inventory and Monitoring Network (APHN) monitors water quality at strategic integrator sites to identify water resource conditions. The network monitors core water quality parameters including:

- Streamflow
- Water Temperature
- Dissolved Oxygen
- pH
- Specific Conductance
- ANC (acid neutralizing capacity)
- *Escherichia coli* (*E. coli*)
- Turbidity
- Trace Metals
- Nutrients
- Major Ions

Current conditions are compared to state and federal standards (TDEC 2019), as well as natural reference conditions within Big South Fork National River and Recreation Area. (Rikard et al. 1986). For detailed methods, see Hughes et al. 2018.

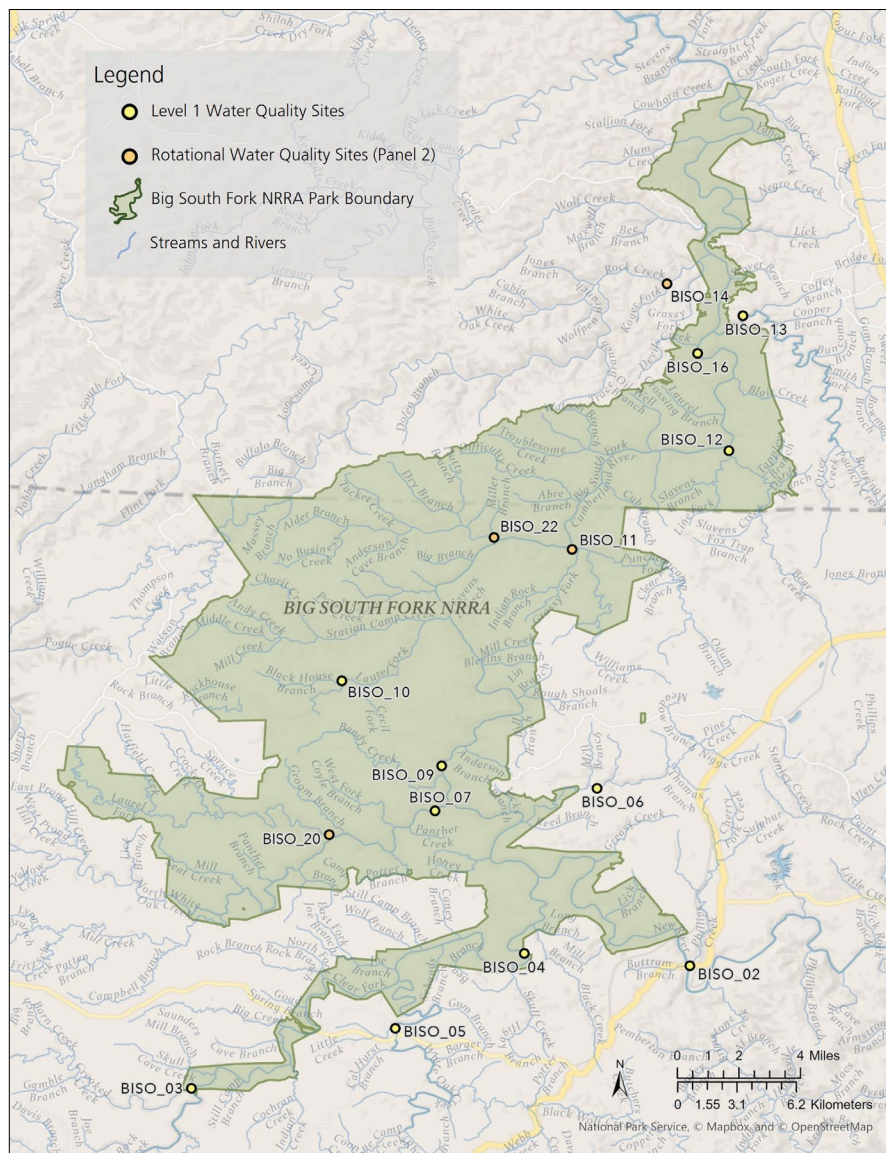


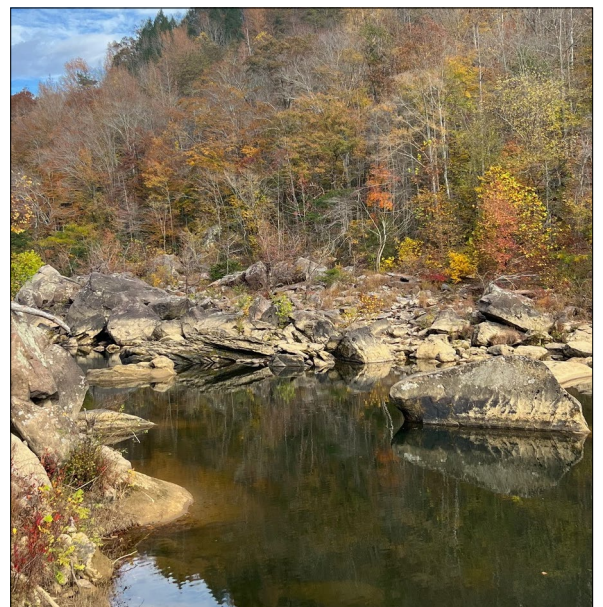
Table of discrete water quality site identification numbers (Site ID), and site location names (Site Name), monitored in Big South Fork National River and Recreation Area during water year 2023.

Site ID	Site Name
BISO_02	New River at New River, Tenn.
BISO_03	Clear Fork at Peters Bridge
BISO_04	Clear Fork at Burnt Mill Bridge
BISO_05	White Oak Creek at Rugby, Tenn.
BISO_06	Pine Creek at Toomey
BISO_07	North White Oak Creek near mouth
BISO_09	Big South Fork at Leatherwood Ford
BISO_10	Laurel Fork at Station Camp Crossing
BISO_11	Williams Creek near mouth
BISO_12	Bear Creek at mouth
BISO_13	Roaring Paunch Creek at Barthell, Ky.
BISO_14	Rock Creek at Devil's Creek Road
BISO_16	Big South Fork at Blue Heron
BISO_22	No Business Creek near mouth
BISO_20	Laurel Fork of NWO at mouth

Map showing discrete water quality monitoring sites in the Big South Fork National River and Recreation Area watershed.



Measuring streamflow at Bear Creek. NPS photo / APHN staff.



Big South Fork at Blue Heron. NPS photo / APHN staff.

Significant Findings

During water year 2023 (WY23), sampling occurred from October 2022 to September 2023. Including QA/QC, 58 samples were collected from 15 sites, following rotational panel 1 (Hughes et al. 2018). As of WY23, sampling periods were reduced from quarterly to triannually.

There were no violations of Tennessee State Water Quality Standards in WY23. Water temperature and dissolved oxygen met all water quality criteria, with temperature remaining below 30.5°C (86.9°F) and dissolved oxygen above 5 mg/l. Water temperature ranged from 5.8°C to 26.3°C with a mean of 16.3°C for all site measurements. Dissolved oxygen measurements ranged from a minimum of 6.8 mg/l to 12.3 mg/l. Mean dissolved oxygen across all sites was 9.6 mg/l.

Natural reference conditions for specific conductance, as there are no state standards, are below 100 $\mu\text{S}/\text{cm}$ (microsiemens per centimeter) in the rivers of Big South Fork NRR and below 50 $\mu\text{S}/\text{cm}$ in smaller streams. Specific conductance was below 100 $\mu\text{S}/\text{cm}$ at most sites (mean = 94.3 $\mu\text{S}/\text{cm}$). Specific conductance was highest at Pine Creek, with a maximum of 483 $\mu\text{S}/\text{cm}$ (Figure 1).

Turbidity was low at most sites (mean = 5.11 FNU [Formazin Nephelometric Units]). Although the overall mean is above the recommended Ecoregion conditions of 2.3 FNU (EPA 2021), median turbidity was closer to this recommendation at 2.51 FNU. Bear Creek was the most turbid site.

The maximum recorded *Escherichia coli* (*E. coli*) concentration was 272.3 MPN/100ml, below the individual sample criteria of less than 487 CFU/100ml for Tennessee Outstanding Natural Resource Waters. The maximum was recorded at Bear Creek, while Pine Creek had the highest average (97.43 MPN/100ml). Mean *E. coli* for all site measurements was 47.0 MPN/100ml. Of note, the difference between MPN (Most Probable Number) and CFU (Colony Forming Units) is the method of measurement but MPN is equivalent to an approximation of CFU.

Acid neutralizing capacity (ANC) is the ability of a stream to buffer or neutralize acid inputs. Streams with ANC below 20 mg/L as CaCO_3 are sensitive to acidification, while streams below 2.5 mg/L as CaCO_3 are highly sensitive. Due to the sandstone dominated geology of the Cumberland Plateau, many streams have low buffering capacity and are considered sensitive to acidification (mean of all streams = 24.65 mg/L CaCO_3). The ANC ranged from 2.57 to 94.49 mg/L as CaCO_3 for all measurements. Laurel Fork at North White Oak, Laurel Fork at Station Camp, Williams Creek, and North White Oak Creek had the lowest mean ANC results, indicating they are more susceptible to acid inputs.

Water quality data are available upon request to the Appalachian Highlands Network. Past water quality reports and briefs are available on the [Appalachian Highlands Network website](https://www.nps.gov/im/aphn/reports-publications.htm) (<https://www.nps.gov/im/aphn/reports-publications.htm>).

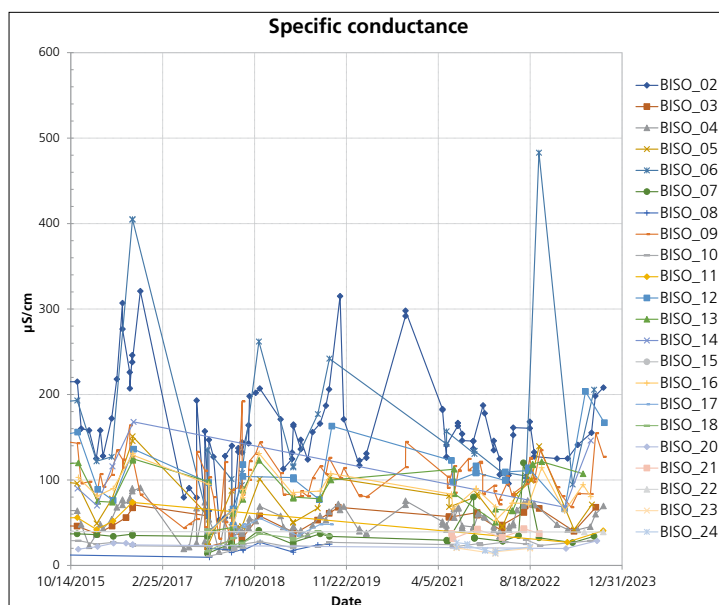


Figure 1. Specific conductance at monitoring sites within Big South Fork NRR from WY2015 to WY2023.

Literature Cited

- Hughes, J., R. Emmott, E. Raskin, and B. Witcher. 2018. Long-term discrete water-quality monitoring at Big South Fork National River and Recreation Area, Blue Ridge Parkway, and Obed Wild and Scenic River: Protocol narrative. Natural Resource Report NPS/APHN/NRR—2018/1840. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2258269>
- Rikard, M., S. Kunkle, and J. Wilson. 1986. Big South Fork NRR Water Quality Report, 1982–1984. NPS Water Resources Report No. 86-7. 65pp.
- Tennessee Department of Environment and Conservation (TDEC). 2019. Revised General Water Quality Criteria.
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